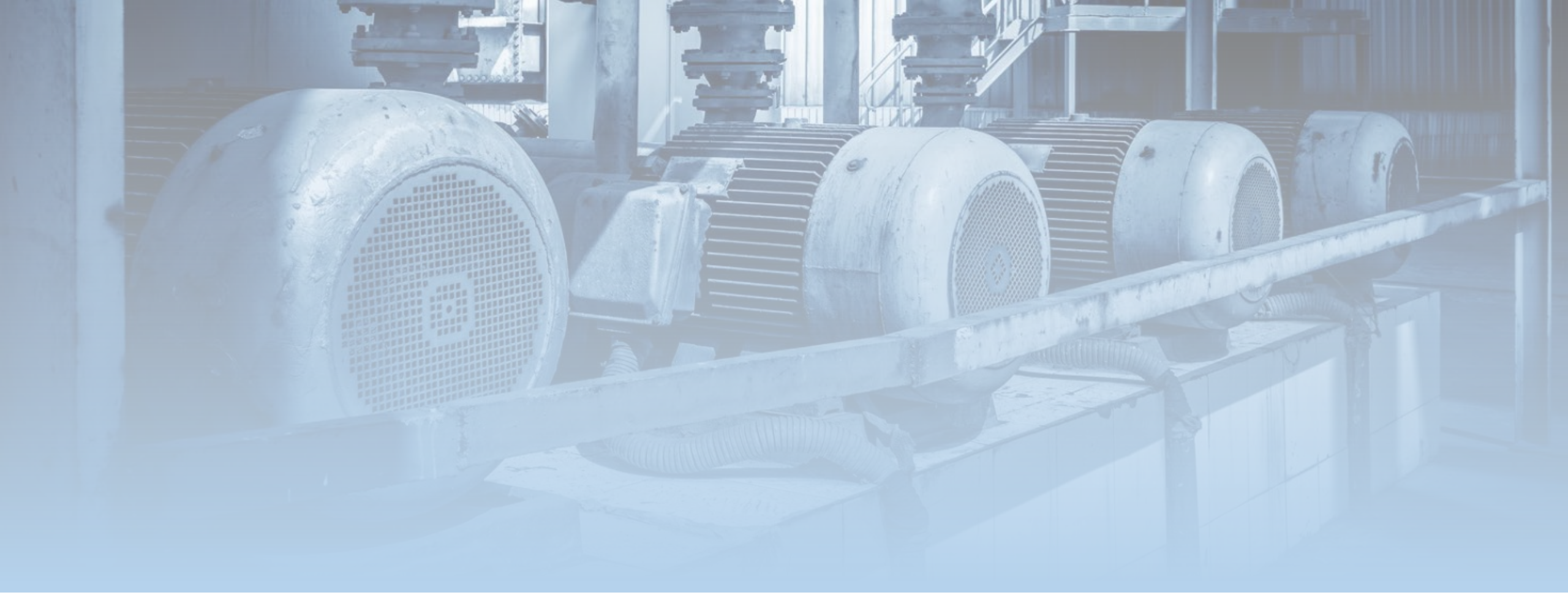




IEEE43 Requirements for Insulation Resistance Testing and the Significance of Polarization Index and Dielectric Absorption

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Motor Insulation Deterioration

Causes and testing method

Continuous Deterioration:

Motor insulation consistently degrades over time.

Stress Factors:

Frequent starts and temperature fluctuations cause insulation to crack.

Moisture Accumulation:

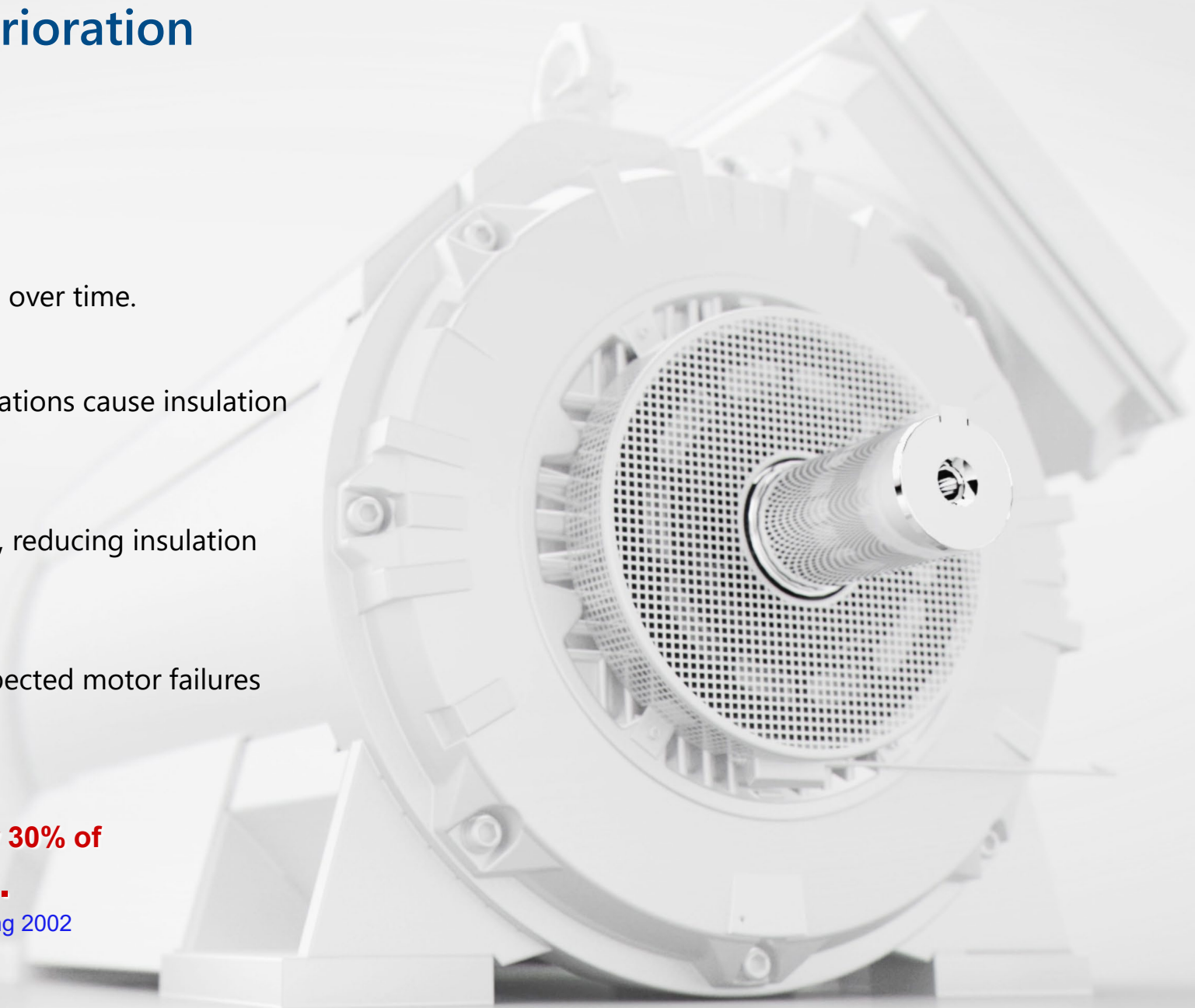
Idle periods allow moisture to build up, reducing insulation resistance.

Consequences of Neglect:

Unchecked degradation leads to unexpected motor failures and costly downtime.

***The IEEE identified approximately 30% of motor failures as insulation related.**

* Institute of Electrical and Electronic Engineering 2002



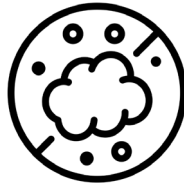
Insulation Monitoring Relay

iMx Relay Application

You need Insulation Monitors if your production conditions involve



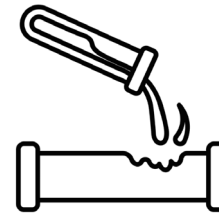
High humidity



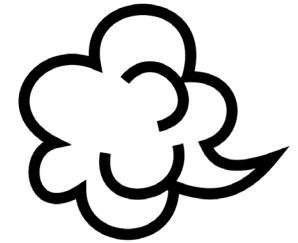
Dust



Wetness



Corrosive



Fumes of any kind



How iMx Relays Work in Practice

Updated Functionality Based on Market Input

- Activates **only after system voltage and capacitance have fully dissipated.**
- Conducts a **10-minute insulation test**, calculating:
- **Polarization Index (PI)**
- **Dielectric Absorption Ratio (DAR)**
- Automatically **shuts off after testing** — no continuous 5,000VDC voltage is applied.
- Before re-energizing the machine, operators can **press the Test button** to perform a second 10-minute check.



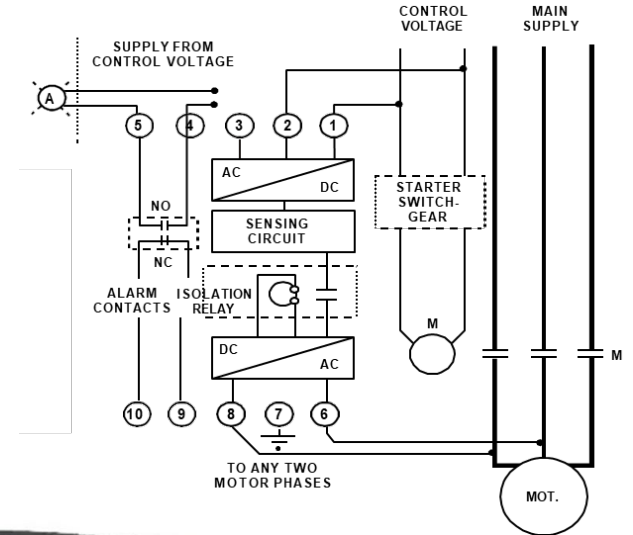
This behavior aligns with preferences from industry, and ensures both safety and compliance with **IEEE 43 and NETA MTS-2019.**

Insulation Monitoring

Two Approaches in the market today

Insulation Monitoring (Permanent installation)

- Performed by a fixed relay with set-points, measuring cable insulation when the equipment is de-energized.
- For use in applications from 600V to 13,800V.
- Activates once system voltage decays. Performs timed testing (PI & DAR) and automatically shuts off — preventing continuous 5,000VDC exposure.
- Test the insulation at NETA rated levels ranging from 250VDC to 5,000VDC
- Provides an alarm if the insulation level drops below a preset level.
- Integral self-test feature.



or

Insulation Resistance Testing (Periodic testing)

- Insulation Resistance Testing is conducted periodically using a DC resistance test set and calculate the dielectric absorption and / or polarization index value for trend analysis.
- A change in the ratios could indicate a potential problem to be addressed.



Insulation Resistance Testing

Importance of Trending (Recommended by IEEE 43)

Why Focus on Trends?

- Individual readings may vary due to environmental factors (e.g., moisture, temperature).
- Trending reveals patterns indicating insulation degradation over time.

IEEE 43 Recommendations

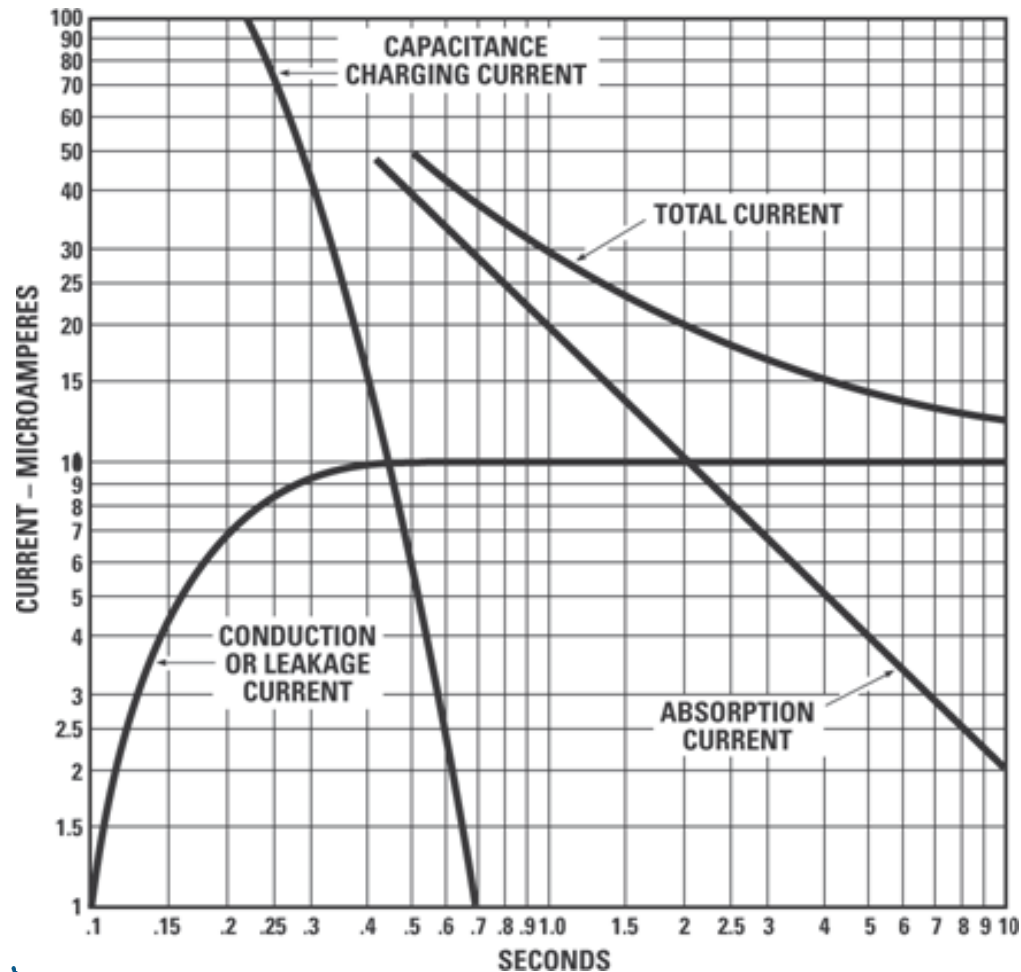
- Machines **>200 HP (150 kW)**:
 - Perform a 10-minute test; calculate **Polarization Index (PI)**.
- Machines **≤200 HP (150 kW)**:
 - Conduct a 1-minute test; calculate **Dielectric Absorption Ratio (DAR)**.

Key Standards:

- IEEE 43: Recommended Practice for Testing Insulation Resistance.
- NETA MTS-2019: Requires testing under IEEE 43 guidelines for critical equipment.

Insulation Resistance Testing

Current in Insulation: Duration Impact



- Capacitance Charging Current

Current that starts out high and drops after the insulation has been charged to full voltage

- Absorption Current

Also an initially high current which then drops

- Conduction or Leakage Current

A small essentially steady current both through and over the insulation.

With good insulation, the conduction or leakage current should build up to a steady value that is constant for the applied voltage. Any increase of leakage current with time is a warning of trouble



Dielectric Absorption and Polarization Index

Insulation Monitoring

Dielectric Absorption and Polarization Index

IEEE 43, NETA MTS 2019, and NFPA 70B mandate Insulation Resistance Tests for calculating Dielectric Absorption Ratio (DAR) and Polarization Index (PI).

Dielectric Absorption Ratio (DAR)

- Ratio of 60-second resistance to 30-second resistance.
- Indicates short-term absorption of insulation.

Polarization Index (PI)

- Ratio of 10-minute resistance to 1-minute resistance.
- Highlights long-term dielectric behavior and moisture effects.

INSULATION CONDITION	60/30-SECOND RATIO	10/1-MINUTE RATIO (POLARIZATION INDEX)
Dangerous	—	Less than 1
Questionable	1.0 to 1.25	1.0 to 2
Good	1.4 to 1.6	2 to 4
Excellent	Above 1.6	Above

Full rated test voltage

Insulation Monitoring

Full rated test voltage

- NETA MTS 2019 recommends using a minimum DC test voltage based on the equipment's nominal voltage. iM relays can produce a 5,000VDC test voltage, enabling insulation monitoring and testing on systems up to 34kV.
- #### Why Test at Full Rated Voltage?
- Ensures insulation can withstand the maximum operating voltage.
 - Detects weaknesses that could cause failure under actual conditions.
- #### Outcome
- Confirms insulation strength and identifies weak points.
 - Provides a safety margin for high-voltage applications.

TABLE 100.1		
Insulation Resistance Test Values		
Electrical Apparatus and Systems Other Than Rotating Machinery		
Nominal Rating of Equipment (Volts)	Minimum Test Voltage (DC)	Recommended Minimum Insulation Resistance (Megohms)
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,500
8,000	2,500	2,500
15,000	2,500	5,000
25,000	5,000	10,000
34,000	5,000	100,000

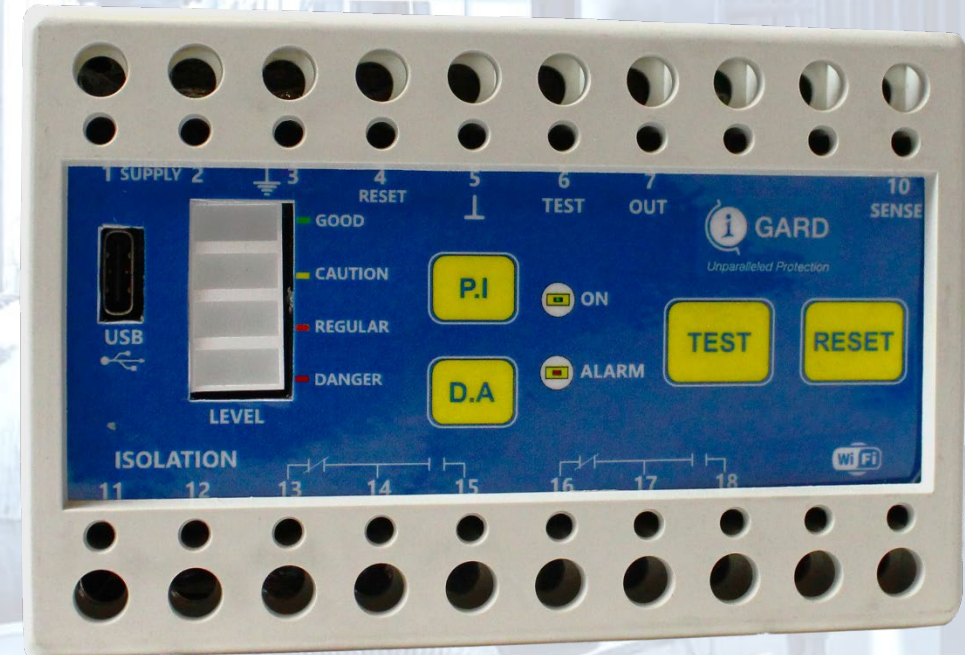
New iM relays are designed to prevent continuous exposure to the full 5,000VDC test voltage. Testing begins only after voltage decay, runs for 10 minutes to calculate PI/DAR, and then the voltage is removed. This behavior aligns with user preferences and preserves insulation integrity.

iRT relay- Coming Soon

Combines Insulation Monitoring and Resistance Testing in one device.

Features:

- Continuous monitoring of de-energized equipment.
- Periodic testing with dielectric absorption and polarization index.
- Data storage and Bluetooth connectivity for trending analysis.
- Full compliance with IEEE 43 and NETA MTS-2019 standards.
- Delayed test start until system capacitance has dissipated.
- 10-minute automated testing with PI and DAR calculation.
- Auto shut-off after testing to avoid continuous high-voltage application.
- Manual re-test function before re-energizing equipment.



Stay tuned for the iRT relay launch, your complete insulation testing solution!

Q&A

